

# Pharmacology & Med Administration – Part 1

Georgia Office of EMS

EMT-I → AEMT Upgrade

CT → CT Update

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## Objectives

- Drug terminology
- Medication Names
- Sources of drug information
- Regulation of pharmaceuticals and drug related laws
- Drug approval process
- Special considerations in drug therapy
- Methods of drug classification
- Drug forms
- Routes of administration
- Pharmacokinetics and pharmacodynamics
- Factors influencing drug interactions
- Medication administration
- Basic cell physiology
- Mathematical principles used in pharmacology and drug calculations
- Intramuscular, subcutaneous, intranasal, and nebulized medication administration

## Introduction

- All medications are poisons if they are given to the wrong patient or in toxic quantities.
- If given inappropriately, medication can cause serious harm or death.
- As an AEMT, it will be your responsibility to be familiar with the medications you will be administering.

## Drug Terminology

- Pharmacology – The study of the properties and effects of drugs and medications on the body
- Drugs – Chemical agents used in the diagnosis, treatment, and prevention of disease
  - Drugs and Medications are often used interchangeably. Try to use the term medication when interacting with patients and families.
- Dose – The amount of medication given
- Action – The therapeutic effect or intended effect that a medication is expected to have on the body
- Unintended effect – Effects that are undesirable but pose little risk to the patient

## Drug Terminology

- Indications – Therapeutic uses for a particular medication
- Contraindications – When a drug should not be given
- Untoward effect – Effects that can be harmful to patients
- Toxicity – The risk that a substance will pose to a human or organism
- Teratogenic – Drug that poses a risk to the normal development or health to an unborn fetus
- Agonist – Drugs that bind to a receptor to cause a response
  - Heroin causes CNS depression
- Antagonist – Drugs that counteract the action of something else
  - Narcan antagonizes the heroin by blocking the receptors site

## Components of a Drug Profile

- Drug name – This includes the generic name, trade name, and chemical name.
- Classification – What type of drug is this? What is it used for?
- Mechanism of action – How does it work? What is its intended purpose?
- Indications – What are the reasons for taking this drug?
- Contraindications – When should this drug not be given? Does it affect certain medical conditions or react with other medications adversely?
- Pharmacokinetics – How is this drug absorbed, metabolized, and what's the half-life?
- Side and adverse affects – Are there any side affects or adverse reactions?
- Routes of administration – How is it given?
- How supplied – What is the total quantity of this medication and in what form?
- Dosages – What's the dosage for adults, pediatrics, and other special groups such as geriatrics and pregnant patients.
- Special considerations – Special considerations for such groups as pediatrics, geriatrics, pregnant patients and other special patient groups

## Medication Names

- Medications are derived from four primary sources which are animals, vegetables, minerals, and synthetic compounds
- Trade name – A brand name that a manufacturer give the medication. It is a proper noun and is capitalized. (Vanceril)
- Generic name – Usually a medications original chemical name. It is not capitalized. (beclomethasone dipropionate)
- Chemical name – Precise description of the medications chemical composition and molecular structure. (9-chloro-11 $\beta$  ...)
- Official name – The name designed by the USP. Usually the generic name followed by USP. (beclomethasone dipropionate, USP)

## Sources of Drug Information

- American Medical Association (AMA) Drug Evaluations
- Physicians' Desk Reference (PDR)
- Formulary
- Drug Inserts

## Laws and Regulation of Pharmaceuticals

- The *Pure Food and Drug Act* (1906) was the first federal legislation aimed at protecting the public from mislabeled, poisonous, or otherwise harmful foods, medications, and alcoholic beverages
  - Required little more than labeling of drugs
- The *Food, Drug, and Cosmetic Act* (1938, amended in 1952 and 1962) provided much more comprehensive legislation.
  - Required labels indicating any potential habit forming substances and possible side effects
  - Authorized the creation of the FDA
  - Mandated that dangerous drugs could only be dispensed with a prescription from a physician, dentist, or veterinarian

## Laws and Regulation of Pharmaceuticals

- The *Harrison Narcotic Act* (1914) regulated the import, manufacture, and sale of several nonnarcotic drugs, and cocaine, opium, and their derivatives.
- The *Narcotic Control Act* (1956) increased penalties for violating the *Harrison Narcotic Act*, made the possession of heroin illegal, and outlawed acquisition and transportation of marijuana.

## Laws and Regulation of Pharmaceuticals

- The Controlled Substances Act (1970) was comprehensive legislation dealing with narcotic and non narcotic drugs that have a potential for abuse.
  - Schedule I – Highest abuse potential and propensity for dependence; no known medical application. (Heroin, LSD, Ecstasy, shrooms)
  - Schedule II – High abuse potential and may lead to severe addiction but not as likely as schedule I. (Amphetamines, opiates, cocaine, demerol)
  - Schedule III – Lower abuse potential than schedule I or II and may lead to low or moderate dependence. (Tylenol with codine, Vicodin)
  - Schedule IV – Lower abuse potential than schedule III and limited dependence potential. (Valium, Ativan)
  - Schedule V – Lowest abuse potential but may lead to some dependence. (Cough syrups containing codine)

## Government Agencies that Regulate Drugs

- The FDA enforces the food, drug, and cosmetic act. They are responsible for determining the safety and efficacy of drugs before they are allowed into the US market.
- The DEA was created by the controlled substance act and is responsible for executing provisions of that act including registration of physicians who are permitted to dispense controlled substances.
- The Public Health Service regulates biologic products such as medications made from living organisms.
- The Federal Trade Commission (FTC) monitors drug advertising and ensures it is not misleading or inappropriate.

## Drug Approval Process

- The average time for a drug to be developed, tested, and approved is nine years.
- Drugs must go through animal studies and clinical trials in humans before they are approved for distribution.
- Clinical trials have four phases.

## Special Considerations in Drug Therapy

- **Pregnant Patients**
  - Before administering medication to female patients, ask whether they are or may be pregnant.
  - Pregnancy changes how a woman's body may react to medication.
  - The health of a mother is priority in an emergency, but the FDA has established a scale to indicate if a drug has documented risks to animals or humans in studies.
    - Category A – No documented risk
    - Category B – Animal studies show no risks to the fetus; however, adequate studies in humans have not been done. Studies in humans have not shown harm in first or third trimester; however, studies in animals have demonstrated adverse effects in the same time period.
    - Category C – Studies in animals have demonstrated adverse effects; however, studies have not been conducted in humans. Drugs in this category also include those which adequate studies have not been conducted in humans or animals.
    - Category D – Risk to the fetus has been demonstrated; however, administration of the drug may outweigh the risks of potential risks to the fetus in certain situation.
    - Category X – Risks of the drug have been demonstrated and should not be given to pregnant patients.

## Special Considerations in Drug Therapy

- Geriatric Patients
  - Pharmacokinetics change in geriatric patients
  - Hepatic and gastrointestinal function slow delaying the absorption and elimination of a drug
  - Geriatrics may be taking several different medications which may modify and interact with each medication

## Drug Classification

- Drugs are classified based upon the effect the drug will have on a particular part of the body or on a specific condition.
- Drugs can be classified into the following three categories.
  - By body system
  - Class of agent
  - Mechanism of agent
- Many medications will fall into different classifications.
  - For example, promethazine (Phenergan) is antiemetic (anti-nausea) and a antihistamine.



# Nervous System Classifications

- Nervous system review
  - Autonomic Nervous System (ANS)
    - Sympathetic
      - Adrenergic response (fight or flight)
        - » Increased HR, respirations, BP, glucose production, and pupillary dilation.
        - Decreases digestive function.
    - Parasympathetic
      - Relaxes the body (rest and relax, or feed and breed)
        - » Normalized HR, respirations, and BP, and increases digestive function.
        - » Over stimulation may cause brady dysrhythmias and pupillary constriction and excessive salivation.

# Nervous System Classifications

- Hormones released by the sympathetic system are carried throughout the body and act upon adrenergic receptors to cause the appropriate response. These receptors are divided into four types.
  - Alpha-1 ( $\alpha_1$ )
    - Peripheral vasoconstriction
  - Alpha-2 ( $\alpha_2$ )
    - Peripheral vasodilation, little to no bronchoconstriction
  - Beta-1 ( $\beta_1$ )
    - Increased HR, automaticity, contractility, and conductivity
  - Beta-2 ( $\beta_2$ )
    - Bronchodilation and vasodilation

## Nervous System Classifications

- Drugs affecting the sympathetic nervous system
  - Sympathomimetics mimic the effects of the sympathetic nervous system.
    - Epi stimulates sympathetic response
  - Symptholytic inhibit the sympathetic nervous system
    - A beta blocker (for hypertension) blocks beta stimulation
- Drugs affecting the parasympathetic nervous system
  - Parasympathomimetics (cholinergic) mimic the parasympathetic response.
  - Parasympatholytics (anticholinergic) block the parasympathetic response.
    - Atopine

## Analgesics and Antagonists

- Analgesic medications are those that relieve pain.
- Opioid agonists are the most common type of analgesic (morphine).
- Opioid antagonists reverse the effects of opioid drugs.
- Opioid agonist-antagonists have both properties
- Nonopioid analgesics are commonly available OTC and also act as antipyretics (fever reducer).
  - Examples include aspirin, Tylenol, and ibuprofen which is a nonsteroidal anti-inflammatory drug (NSAID)

## Antianxiety, Sedative, and Hypnotic Drugs

- Benzodiazepines are common for use in patients preceding evasive procedures as well as patients experiencing seizures
  - These drugs are thought to affect the neurotransmitter GABA in the brain slowing brain function
- Barbiturates are believed to work similarly to benzodiazepines
- Nonbarbiturate hypnotics are believed to work similarly to benzodiazepines and barbiturates but produce fewer side effects.

## Anticonvulsants

- These medications are thought to work by inhibiting the the influx of sodium into the cells
- Other types of anticonvulsant drugs include benzodiazepines and barbiturates

## Stimulants and Depressants

- Stimulants excite the CNS by increasing excitatory neurotransmitters or decreasing inhibitory neurotransmitters and are used to treat headaches, increase wakefulness and awareness, and reduce drowsiness
  - Cocaine, amphetamine, caffeine
- Depressants slow brain activity and may be used to treat anxiety, muscle tension, pain, insomnia, or panic attacks
  - Ativan, Valium, Xanax

## Psychotherapeutic Drugs

- Most psychotherapeutic drugs work by blocking dopamine receptors in the brain
- These medications may cause orthostatic hypotension, sedation, and extrapyramidal symptoms (EPS)
  - A patient with EPS will exhibit involuntary movement, tremors, rigidity, muscle contractions, restlessness, and changes in breathing and heart disorders
- Depression is a common disorder for which treatments are available

## Cardiac Drugs

- The various effects on the heart are categorized as follows
  - Chronotropic – Affects the heart rate
  - Inotropic – affects the force of contraction
  - Dromotropic – Alters the velocity of electricity through the heart.
- All three effects can be positive or negative

## Cardiac Drugs

- Cardiac Glycosides
  - These drugs block certain ionic pumps in the heart
- Antiarrhythmic Medications
  - Sodium Channel Blockers
  - Potassium Channel Blockers
  - Calcium Channel Blocker

## Cardiac Drugs

- Antihypertensive Medications have the following treatment goals: keep BP within normal range, maintain or improve blood flow, reduce stress on the heart.
  - Diuretic medications cause the kidneys to remove excess salt and water from the body
  - Vasodilators act on smooth muscles in the arterioles
  - Sympathetic blocking agents block the beta adrenergic receptors
  - Angiotensin-converting enzyme (ACE) inhibitors targets the renin-angiotensin-aldosterone (RAA) system.

## Cardiac Drugs

- Anticoagulants, Fibrinolysis, and Blood Components
  - Antiplatelet agents interfere with the aggregation , or collection of platelets. They do not break down platelets; they prevent further build up of these blood cells.
    - Aspirin
  - Anticoagulant prevent thrombi from forming
    - Heparin, warfarin
  - Fibrinolytic agents dissolve thrombus
    - tPA

## Respiratory Drugs

- Oxygen is the most commonly used medication in the pre-hospital setting
- Patients may take OTC respiratory medications for illicit use.
- Many respiratory medications try to expand the airway by using a sympathomimetic response
  - Albuterol, epinephrine
- Xanthines relieve airway constriction by relaxing the smooth muscles and making the heart work harder
  - Caffeine
- Some respiratory medications work by reducing inflammation in the airway
  - Solumedrol

## Drugs Affecting the Pancreas

- A wide variety of medications that affect the pancreas are available
- Many do not act on the pancreas itself, rather alter the way the insulin is used in the body
- Some medications affect how the beta cells in the pancreas work

## Drugs Affecting the Immunologic System

- Patients who have undergone organ transplant may be on immunosuppressant medications
- Immunosuppressant medications inhibit the body's ability to attack the "foreign" organ, or in the case of autoimmune disease, the medication inhibits the body's attack on its self
- These medications can affect the way the body fights infection

## Vitamins, Minerals, Fluids, and Electrolytes

- Patients might be taking vitamin and mineral supplements to replace deficient items as a preventative measure.
- Several types of IV fluids may be administered to patients and will be discussed later
  - Crystalloids
  - Colloids



# Drug Forms

- Solid Drugs
  - Tablet, capsules, gelatin shells
- Liquid Drugs
  - A solution is a solution of one or more substances that cannot be separated by filtering or allowing the mixture to stand
  - A substance that can be evenly distributed throughout a liquid by shaking or stirring
- Metered-Dose Inhalers
  - Miniature spray canister used to direct medications into the mouth and into the lungs
- Topical Medications
  - Lotions, creams, and ointments that affect only that area
- Transcutaneous Medications
  - Medications designed to be absorbed through the skin
- Gels
  - Semiliquid substance administered orally
- Gases
  - Oxygen, nitrous oxide

# Routes of Drug Administration

- The route we will discuss today are:
  - Subcutaneous (SC)
    - Beneath the skin between the skin and muscle
  - Intramuscular (IM)
    - Into the muscle
  - Intranasal (IN)
    - In the nose using an atomizer
  - Inhalation
    - Nebulized medications

## Pharmacokinetics

- Pharmacokinetics refer to the movement of a drug through the body in four stages: absorption, distribution, metabolism, and elimination
  - Many things can effect the absorption such as the nature of the absorbing surface, blood flow to the site, solubility of the solution, pH, drug concentration, bioavailability, diffusion, osmosis, and filtration
  - Some areas of the body, such as the brain and placenta, are less accessible to certain drugs than others
  - Drugs are eliminated by the kidneys via urine, intestines through feces, lungs via respiration, sweat through the salivary glands, and the mammary glands through breast milk

## Pharmacodynamics

- Mechanism of action is the way in which a medication produces the intended response
- To produce the desired response, therapeutic doses must be administered
- Onset of action – time it will take for the medication to reach the minimum therapeutic level
- Duration of action – How long the medication can be expected to remain above that minimum level to provide the intended action
- Termination of action – The time after the level falls below the minimum level to the time its eliminated from the body
- Therapeutic index – The ratio of a drug's lethal dose for 50% of the population ( $LD_{50}$ ) to its effective dose for 50% of the population ( $ED_{50}$ )
- Therapeutic Threshold – The minimum effective concentration
- Be aware of the potential interaction of medications that patients may be self-administering

## Factors Influencing Drug Interactions

- Polypharmacy – Taking several medications each day
- Predicted response
  - Side effects are actions of a medication other than desired ones
- Iatrogenic Response is an adverse condition inadvertently induced in a patient by the treatment given
  - Provider caused!!!

## Factors Influencing Drug Interactions

- Unpredictable Response
  - Hypersensitivity – “allergic reaction”
  - Serum sickness – Similar to hypersensitivity but occurs a considerable time after stimulus
  - Idiosyncrasy – A particular person's reaction to a drug that is not expected
  - Tolerance – A built up resistance to medications due to prolonged exposure to said medication
  - Refractory – When a condition does not respond to treatment
  - Cumulative effect – An increased effect when a medication is given in several successive doses
  - Drug dependence – A psychological and sometimes physical state resulting from continued use of a substance
  - Habituation – Physical tolerance and dependence on a drug
  - Drug interaction – One medication altering the response of another; can be fatal
  - Summation – Two drugs that have similar effects increase the patient's response when given together
  - Synergism – Two drugs given together that produce a response greater than the sum of their individual responses (1+1=3)
  - Potentiation – When one drug enhances another drug's effect (Phenergan + morphine is an expected response)

## Drug Storage and Security

- Drug boxes should be carefully guarded against possible theft
- In the case of controlled substances, records must be kept separate from other paperwork
- All medications should be stored in consistent temperature if possible

END PART 1